Development of Handheld Erythema and Bruise Detectors

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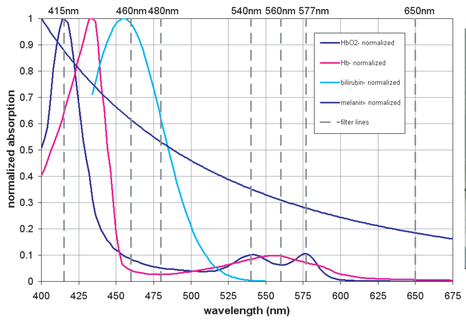
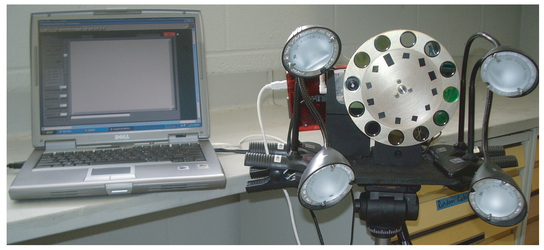
Aim

The overall goal of the project is to develop two clinically affordable handheld devices, based on multi spectral imaging technology, which can identify incipient pressure ulcers and bruises.

Background



Normalized absorption curves of chromophores of interest.



The multispectral imaging system

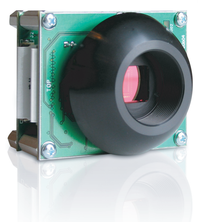
- CCD camera
- 12 filter wheel

Proposed Devices

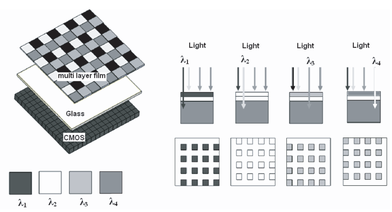
E&B Scanner

A low-cost handheld scanning device designed to answer the questions, “is it a bruise” or “is it erythema”.

- Camera Sensor: Lu120 Lumenera Corp.



- Custom CMOS Filter Array

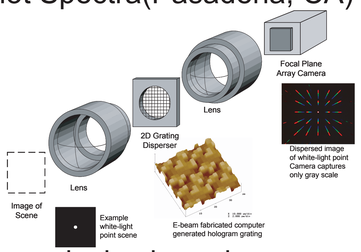


E&B Sensor

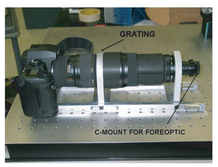
A device designed to specifically characterize erythema and bruising.

- Distinguishing between reactive hyperemia and a Stage I ulcer.
- Able to approximate bruise age.

The device is based on a computed tomography imaging spectrometer (CTIS) developed by Snapshot Spectra(Pasadena, CA)

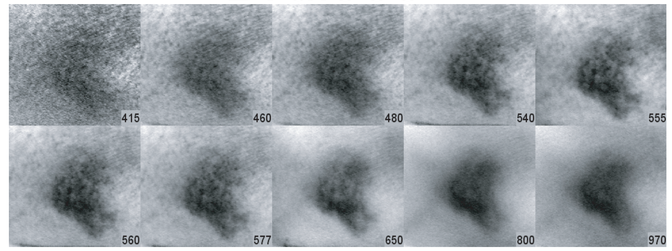


Prototype device based upon a consumer SLR camera; Diffractive grating is the non-commercial component.



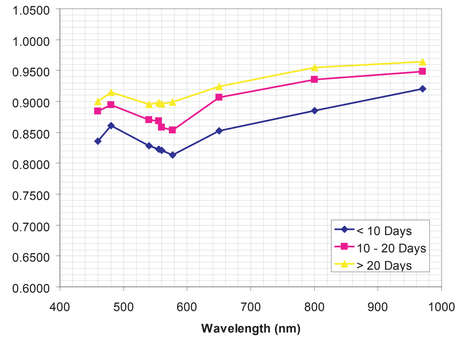
Bruises

- 13 residents of an extended care facility.
- A normalized bruise ratio (NBR) was calculated from bruised and uninvolved skin



Typical series of multispectral images obtained from a two week old bruise.

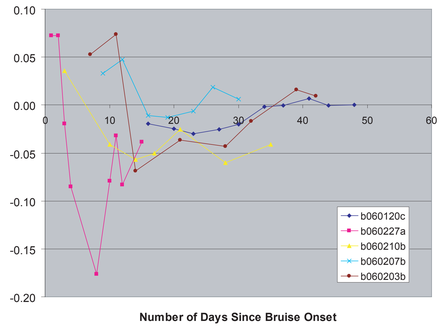
Mean NBR for Bruises in 3 Age Groups



As the age of the group increases, the mean NBR values approach zero.

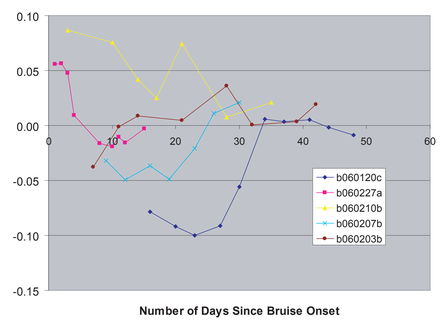
Bruising Over Time

(nbr460-nbr650)



NBR highlighting bilirubin illustrates increase from 10 to 30 days.

(nbr460-nbr540)



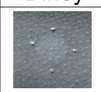
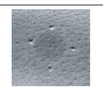
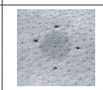
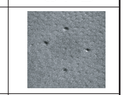
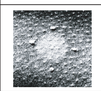
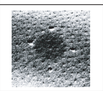
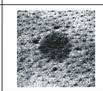
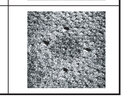
NBR isllustrates complex relationship between bilirubin.

Erythema

- Erythema was induced at the shank of 56 subjects with varying skin pigmentation.
- 5 fusion algorithms determined ability to contrast erythema, GT-A classifier offered the best detection.

Weber Contrast Valves

Subject Set	Digital Camera	GT-A	
		w/o hist. eq.	w/ hist.eq.
All Subjects	0.031	0.201	0.628
African American Subjects	0.028	0.182	0.544

Visible Erythema	Fused Images			
		Diffey	Tronnier	GT-A	GT-B
	Fused				
	Fused w/ Histogram Equalization				

Classification results for African American subjects

GT-A Classifier	+ Predictive Value	- Predictive Value	Accuracy (%)
w/o hist. eq.	1.00	.889	91.7
w/hist. eq.	1.00	.918	94.0

Classification results for all subjects

GT-A Classifier	+ Predictive Value	- Predictive Value	Accuracy (%)
w/o hist. eq.	.778	.933	87.5
w/hist. eq.	.962	.948	95.2